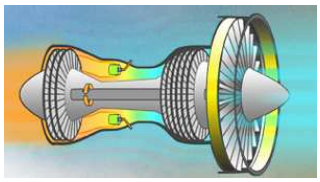
Controlo Integrado da Produção / Modelação e Controlo de Sistemas de Produção

Projecto de modelação e simulação

2º Semestestre MEMec / MEIC-A, 2007/08



JEC - Jet Engine Company

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Open call to tender Jet Engine Company for the provision of consultancy services in Systems Modeling and Simulation

1. Invitation to tender (Open Procedure):

1. The Jet Engine Company (JEC) is a renowned company that is specialized in the design and manufacturing of jet engines for commercial airplanes and supplies several major aviation manufacturers.
2. The JEC headquarters is based in Lisbon, the production facility is located in Alverca, while the maintenance facility is located in Braga.
3. In order to maintain its high production standards, therefore complying with the stakeholder's financial interests, as well as with the customer's logistic requirements, the JEC administration board has decided to assess the effectiveness of restructuring the production.
4. Therefore, the JEC is hiring consultancy services in Systems Modeling and Simulation to support the activities of the Industrial Engineering department, which is in charge of conducting the assessment procedure.

2. Tender specifications

2.1 Description of the manufacturing process

The process of building a jet engine is outlined below:

1. Kiting components: at this stage all the individual parts of an engine are put into kits. The kits are created such that all the hardware needed for a particular assembly is included in one single unit. Each of these kits is then moved to the assembly floor when needed.
2. Module build-up: a jet engine is broken down into six assembly areas that build the engine modules separately. The six modules are listed below.
    - High pressure compressor (HPC) module
    - Diffuser/Combustor module
    - First Vane module (This includes the vanes directly after the burner)
    - High pressure turbine (HPT) module (This is the turbine that drives the HPC).
    - Fan and Low-pressure compressor (LPC) module
    - Low pressure turbine (LPT) module (This is the turbine that drives the Fan/LPC).

These modules are then assembled together to form the engine.

3. Mating modules: during this step the six modules listed above are assembled together. The modules are required in the order listed in the above module build-up section. The HPC module is mated to the Diffuser/Combustor module. Next the HPC/Diffuser/Combustor assembly is mated to the First Vane module and then to the HPT module forming the core. The core is then mated to the Fan/LPC module. Lastly the LPT module is mated to the back of the HPT module. This process completes the major assemblies of an engine.
4. Externals: all the external tubing, wire harnesses, and control systems are installed on the engine. This step completes the engine assembly processes.
5. Testing: during the testing stage the engine is run in a test stand to break-in the engine and to perform a final checkout on all engine components before shipping the engine to the customer. The break-in involves running a test on the engine that sets clearances in the engine to obtain the best performance and durability of the engine. The final inspection includes final sign off of all documentation and a thorough review of the engine to ensure that the engine is ready to fly on a commercial airline.
6. Packing and shipping: upon completion of the building process, the engines are timely shipped to the customer's warehouses in packs of two.

The beginning of the assembly process for a jet engine is triggered when an order is placed by the customer. The current production planning is a Materials Requirements Planning (MRP) system, which requires that the order for a new engine must be placed with, at least, three months in advance of the production starting date, and requires large inventories as well.

The system data and layout will be made available upon request from the consultancy company.

2.2 Problems

Often in the current assembly process delays occur during which a module or assembly sits idle at the assembly or test area. This can occur for a variety of reasons, including late delivery of parts or kits, inventory breakdown, workstation maintenance, or lack of manpower. Delays of this kind severely impact both schedule and budget and therefore are very undesirable.

Both the inventory policy and the assembly framework that are being currently used are too restrictive regarding the long interval from order reception to engine delivery. It would be advantageous to reduce this long lead time.

The jet engine maintenance process shares most procedures with the assembly process. The only difference is that in the first step the engine is disassembled into its parts and the defected components are replaced with new ones. In order to reduce the logistic costs of having two facilities that are geographically dispersed, although working in parallel, the possibility of moving the unit in Braga to the Alverca facilities has to be investigated.

It is expected that the recommendations produced as a result of the consultancy work effectively contribute towards the successful resolution of these issues.

2.3 Objectives and scope

The global objective of this project is to provide a decision support tool to the engineering department at JEC that will assist in evaluating the necessary actions needed to improve the company performance. A working simulation model that suitably reproduces the process for the production of a jet engine has to be implemented using Arena. This model will allow analyzing the process in order to determine areas that must be improved to cope with the problems of Section 2.2. In order to satisfy this objective, four functional requirements will be addressed under this contract:

R1. Optimization of the current assembly system;

R2. Merging of both assembly and maintenance systems into a single facility;

R3. Transition of the MRP system to a pull system using Kanban cards.

R4. Definition of rescheduling and policies to prevent disruptions due to common problems, e.g. workstation maintenance, inventory breakdowns, or others.

The analysis and recommendations produced by the consultancy company should consider the following set of scenarios:

1. implementation of each requirements individually;
2. implementation of R2 and R4
3. implementation of R3 and R4
4. implementation of R2, R3 and R4

2.4 Deliverables

- **Step 1 (Functional Specification):**
  - "Agreed and accepted" statement by JEC and the consultancy company
  - Project management documentation including a reporting system:
    - project charter
    - project plan (including timeline and milestones)
    - management procedure (including assigned tasks)
    - project status reports
    - flash reports (every week)
  - Software development plan
- **Step 2 (Final Report):**
  - Simulation model documentation, including but not limited to,
    - Variable listing
    - Entity attributes
    - Station queues
  - User's manual
    - Functional Specification
    - Input/output data files
    - Software
    - How to use the model
  - Model validation
  - Analysis of results and recommendations

JEC

Lisbon, 4.4.2008